Training Workshop: Use of the NCEP GEFS and the NAEFS in Operational Weather Forecasting
Monday 8 October – Friday 12 October 2007

Monday

Session 1 Overview of NWP, NAEFS, and sources of data

08:00 Overview of numerical weather and climate prediction methods, ***Zoltan Toth***
Objectives: To discuss the basics of numerical weather prediction methods. Of particular interest: the observing system, data assimilation, numerical modeling methods, and techniques for statistical bias correction, are discussed.

09:00 Introduction to chaos theory and forecast uncertainty, ***Zoltan Toth***
Objectives: To show how to assess uncertainty in weather and climate forecasts. Ensemble methods are presented, including how to diagnose uncertainty in ensemble forecasts. Topics to be discussed include Chaos and Lorenz Attractor, uncertainty by spread, and probabilities.

10:15 Coffee Break

10:30 Use of single numerical forecasts in weather forecasting: Showcases of model *jumpiness*, ***Richard Grumm***
Objectives: To show how to recognize uncertainty in forecasts. The course provides examples of uncertainty in the NCEP GFS and its impact on ensemble prediction system. The course includes a definition of model jumpiness, the visualization of uncertainty in deterministic forecasts, and how to leverage model jumpiness in the forecast process.

11:30 Overview of the NAEFS and CMC ensemble predictions systems, future plans, strengths, and limitations, ***Zoltan Toth***
Objectives: The North American Ensemble Forecast System (NAEFS) is a new weather modeling system run jointly by the National Meteorological Service of Canada and the US National Weather Service (NWS). The course discusses the functionalities of the NAEFS, the output variables, and the link with the THORPEX Integrative Grand Ensemble (TIGGE) data base.

12:30-14:00 Lunch

Session 2 Need for ensembles: Assessing uncertainty in forecasts and products

14:00 Introduction to ensemble products to identify uncertainty in weather forecasts, ***Bill Bua***
Objectives: To show how to analyze and interpret ensemble products, including spaghetti diagrams, plume diagrams, mean, and spread charts, probability of exceedance diagrams and plume diagrams. To apply these products in probabilistic terms. Forecast case examples are shown.

15:00 The NCEP global ensemble forecast system (GEFS) and forecasting significant weather events over Africa**,** ***Bill Bua***
Objectives: To show how to forecast potential for severe weather events. Both deterministic and ensemble products are used to diagnose synoptic and mesoscale features.

16:15 Break

16:30 Lab 1: Accessing NCEP GEFS data, ***Richard Grumm***
Objective: To show how to access the NCEP GEFS products and how to use the data to identify areas of high uncertainty in the forecast. The 17-21 January 2007 case will be used. The lab session includes:

- Introduction to the GFS and GEFS web page and contents
- Use of the deterministic GFS in the forecast process
- Application of the concept of jumpiness to GFS forecasts

18:00 End of Day

Tuesday

Session 3 Factoring Climate into the Forecast Decision

08:00 Understanding Climate Part I: Regional Climate, ***Willem Landman***
Objective: To review the basic state of the African climate. To describe the circulation features and the synoptic scale patterns of the African climate, including the interactions between tropical and mid-latitude systems. To review the importance of the Atlantic and Indian Ocean on African weather systems

09:00 Understanding Climate Part II: Linking the case studies to the state of the global climate, ***Wassila Thiaw***
Objective: To review the large scale features associated with African climate variability. Of particular interest are global scale modes of variability such as ENSO, the MJO, etc., and how these influence the African climate. The presentation also discusses the state of the global climate as it relates to the case studies.

10:15 Break

Session 4 Probabilistic forecasting: Statistical background and using probabilistic data when making forecasts

10:30 Introduction to basic statistics and leveraging statistical concepts using ensemble data, ***Bill Bua***
Objective: To review statistical methods used in ensemble prediction, including measures of “middleness” and “shape”, theoretical probability distributions, and other concepts.

11:30 Introduction to probabilistic ensemble forecast products to aid in the forecast process, ***Bill Bua***

Objective: Application of information from the previous lecture to ensemble data. Show how ensemble products are constructed, and how to interpret these products when making forecast decisions.

12:30 Lunch

14:00 Lab 2A: Use ensemble products to produce a forecast relating the potential threat to the uncertainty, ***Grumm/Bua***

The event of 20-21 January 2007 will be revisited from an ensemble forecast perspective. Objective:

- Using the GEFS in conjunction with the GFS to see alternative outcomes in the forecast process
- Making a forecast and assessing confidence based on uncertainty

16:15 Coffee Break

16:30 Lab 2B: A cold-season event of 27 June 2007, ***Grumm/Bua***

Objective: To learn how the cold season, dominated by extratropical processes, differs from the warm season. To assess the risk of significant weather in the cold season; To use the GEFS and NAEFS in the cold season forecast process to see alternative solutions to those provided by the deterministic GFS.

18:00 End of the Day

Wednesday Session 4 (Cont'd)

08:00 Lab 2C Practice: Heavy rainfall event of 23-25 February 2007. Use of the GEFS to aid in identifying and forecasting heavy rainfall in southern Africa, ***Bill Bua/R.Grumm***

Objective: To demonstrate how to access data for real time use in operational weather forecasting.

- Use probabilistic NAEFS products to identify areas of high probability of significant weather (heavy rain and other significant phenomena)
- Use probabilistic NAEFS products to produce a forecast relating the potential threat for significant weather
- Produce a forecast using NAEFS data

10:15 Coffee Break

10:30 Lab 2D Practice: Impact of Tropical Cyclone Favio, 21 February 2007

12:30 Lunch Break

Session 5: Verification and leveraging climatological data in the forecast process

14:00 Verifying NCEP NAEFS ensemble and probabilistic forecasts, ***Zoltan Toth***
Objective: To discuss the importance of forecast verifications to determine errors and to diagnose error sources. The presentation will address the data sets needed for verifications. It will also address verification methods, measures and scores. Examples of verification data and techniques for bias correction are covered.

15:00 Application and operational use of bias corrected ensemble data, ***Richard Grumm***
Objective: To show how to apply and use verification information (bias correction) in operational weather forecasting.

16:15 Coffee Break

16:30 Assessing case dependent variations in forecast skill, ***Zoltan Toth***
Objective: To review various approaches to assess flow dependent variations in forecast skill, including the relative measure of predictability, and various confidence intervals and indices; provide an introduction to the use of ensembles and ensemble confidence graphics and how these can help in the forecast decision making process.

18:00 End of Day

Thursday Session 5 (Cont'd)

08:00 Probabilistic forecasts and climate data: Incorporating forecast uncertainty into final products, ***Richard Grumm***
Objective: To show how to access data to derive climatology. To discuss the NCEP global reanalysis data, precipitation data sets, alarm bell maps. The presentation also discusses anomalies and departures from climatological probabilities and significance. The climatological data used to develop applications and products is presented.

Session 6 Special Topics (Lab) WINGRIDDS
Objective: To show how to use the WINGRIDD software to download and display NCEP GFS data on the internet, in either contour or vector format for a variety of forecast fields. The package also allows the user to extract a variety of information from meteorological diagnostic parameters computed from the gridded data fields.

09:00 Introducing WINGRIDDS Applications, ***Sergio Buque***
10:15 Break
10:30 WINGRIDDS (Cont'd)
12:30 Lunch
14:00 WINGRIDDS Practice
16:15 Break
16:30 WINGRIDDS Practice

18:00 End of Day

Friday

Session 7 Applications in Operational Forecasting

08:00 Best Forecast Practices, ***Richard Grumm***
Objective: To discuss operational oriented forecast techniques using GEFS data. The discussion is based on a historical case study but presented in a portable web format to simulate real time forecasting. Emphasis is on forecasting significant events over southern Africa.

09:00 Case Study and Model Performance Part I, ***Richard Grumm***
Objectives: To review the case studies from the workshop in light of best practices related to

- Deterministic GFS model performance
- Relationship of deterministic GFS performance to GFS ensemble (GEFS)
- The effect of the multimodel ensemble (NAEFS) on the ensemble forecast

10:15 Coffee Break

10:30 Case Study and Model Performance Part II, ***Bill Bua***
Objectives: To present general performance information for GFS, GEFS, and NAEFS over the southern African region.

- Synoptic scale seasonal statistics for GFS (anomaly correlation, bias and RMSE, precipitation statistics [if adequate data available for such analysis])
- Synoptic scale statistics for the GEFS and the NAEFS (ensemble mean standard scoring as above, probabilistic verification by season, effect of bias correction)
- General discussion of limitations of ensemble prediction systems and predictability

12:30 Lunch Break

Session 8 Participants Feedback

14:00 Country Working Groups
Objective: To give an opportunity to the representatives from each country to present on forecast practices in their respective NMHSs. Participants will have 2 hours to prepare a presentation on how they feel this training could be helpful to improving forecast operations in their respective countries.

16:15 Break

16:30 Country Presentations
17:45 Final notes, follow-on contacts, and Adjourn
18:00 End of Training